High-Bandwidth Photon-Counting Detectors with Enhanced Near-Infrared Response, Phase I

Completed Technology Project (2009 - 2009)

Project Introduction

Laser optical communications offer the potential to dramatically increase the link bandwidth and decrease the emitter power in long-range space communications. Newest system designs require photon-counting arrays operated at high detection efficiency, tens of picoseconds temporal resolution, and capability to handle high detection rates at the wavelength of the laser beam. We propose to develop a novel photon-counting detector array in near infrared, operated with moderate cooling, high-detection efficiency, high saturation counting rate, and capable of high timing resolution. In Phase I, we will investigate methods to integrate photon absorption enhancement techniques into the photon detector process flow and demonstrate the elements of the technology yielding photon-counting detector arrays with high detection efficiency at 1064 nm, high bandwidth and saturation-counting rate. In Phase II, we will integrate the new process flow with readout electronics into compact photon-counting arrays using hybrid and monolithic integration technologies. Detector and readout circuit design will be improved to meet the detection efficiency, noise, timing resolution, and linearity requirements.

Anticipated Benefits

In addition to long-range optical communications, larger arrays could be fabricated for single-photon imaging in the infrared and visible spectra with applications to security cameras, imaging of non-cooperative targets, single-molecule detection, integration into micro fluidic devices, biochips for biomedical applications, fluorescence correlation spectroscopy, underwater imaging to many attenuation depths, as well as laser Doppler imaging and optical tomography in medical applications and cancer research. Due to their extremely short integration time, infrared photon-counting arrays could find applications in high-speed imaging.

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Table of Contents

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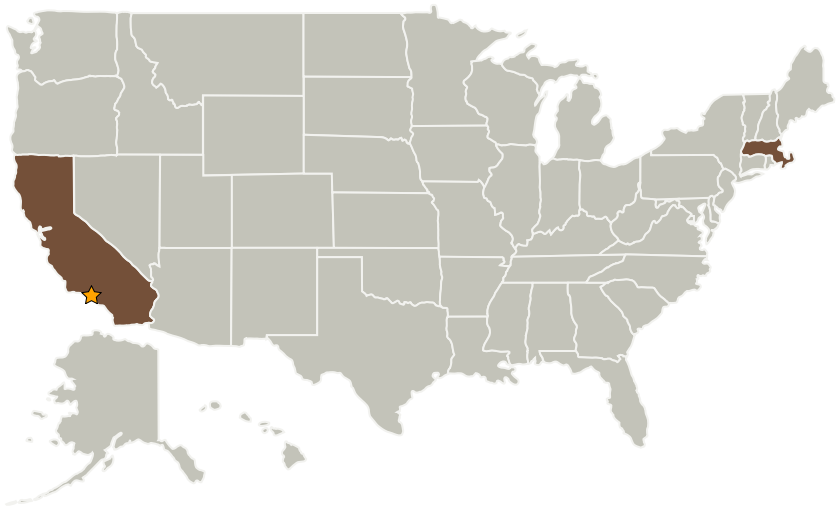
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California
aPeak, Inc.	Supporting Organization	Industry	Newton, Massachusetts

Primary U.S. Work Locations	
California	Massachusetts

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Celestino Jun Rosca

Principal Investigator:

Stefan Vasile

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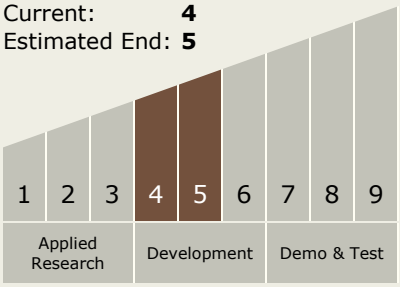
Technology Maturity (TRL)

Start: **4**
Current: **4**
Estimated End: **5**



Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - TX05.1 Optical Communications
    - TX05.1.1 Detector Development